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X-RAY DIAGNOSTIC DEVICE FOR MAMMOGRAPHY
[Röntgendiagnostikgerät für die Mammographie]

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X-rays of the female breast are generally taken with very soft radiation (corresponding to a tube voltage of 20 to 50 kV). The dimensions of the breast which decrease considerably toward the edges lead to considerable density differences on the film, which causes the edge regions of the breast to be extremely overexposed, thus making a diagnosis in this region difficult. To avoid such overexposures due to differences in the thickness of the breast, various solutions are known.

The so-called "Dobretzberger method" proposes that the breast be suspended in a container and that the remaining space within the container be filled with a breast-equivalent liquid, i.e., a liquid, the adsorptive capacity of which is equivalent to that of the breast. Thus, in regions in which the breast is thinner, more liquid is present, thus making it possible for the density differences on the film to be largely compensated for. The disadvantage is that the breast has to be brought into direct contact with the liquid and that a well-defined fixation of the breast is not possible, which under certain circumstances, especially when the exposures are relatively long, may lead to motion blurs.

It is also known to use a wedge-shaped Plexiglas filter to compensate for the various absorption differences. This filter, however, cannot be used near the film, i.e., also not near the breast, but must be attached somewhere in the vicinity of the X-ray tube. This makes an accurate adjustment very difficult.

A slight improvement is possible with the use of a compression mechanism by means of which the breast is pressed against the support surface, in most cases the film holder, by means of a compression plate or a compression tube. This ensures that at least a certain region of the breast is compressed to a uniform thickness. But again, it is not possible to completely avoid an overexposure in the edge region.

Thus, the problem to be solved by the present invention is to design an X-ray diagnostic device for mammography with a compression mechanism in such a way that faulty exposures of parts of the mammogram are largely avoided while making handling simple.

This problem is solved according to the present invention by the characterizing portion of the main claim. The cushion should preferably be placed so that during the X-ray, the breast comes to lie between the cushion and the film, thus ensuring that the diagnostically interesting details are located in the vicinity of the film.

This invention will be explained in greater detail below on the basis of several practical examples which are shown in the drawing.

Each of Figures 1 through 3 shows a diagrammatic and cross-sectional view of various practical examples of the present invention.

In Figure 1, breast 1 is lying on a support surface 2 which is preferably also the film holder. The breast is compressed by means of a compression plate which has a handle 4 and which can be moved up and down as indicated by the arrows. Attached to the lower surface of said plate is a cushion 5 or bag which is filled with a breast-equivalent liquid and which consists of a stretchable material. When the breast is compressed by means of the compression plate, the liquid is displaced in the regions in which the compressive load per unit area is highest; as a result, it is distributed into the direction of the thinner regions of the breast. The lateral boundary of compression plate 3 (above and below the drawing plane) curves downward (not shown), which prevents the liquid cushion 5 from moving sideways when the compressive force is exerted.

Figure 2 shows a second embodiment in which the cushion is not connected to the compression plate but instead is a separate accessory which, during the X-ray, is pushed between the compression plate and the breast. In Figure 2, the elements corresponding to those in Figure 1 have the same reference numerals.

Figure 3 shows yet another embodiment of the invention. In this case, cushion 5 is connected via tube 6 to a storage container (not shown). After compression has been exerted, the liquid is conducted from the storage container into the cushion; at the end of the X-ray, the liquid is returned into the storage container.

The liquid can be displaced from the storage container into the cushion by means of a gas blanket which inside the storage container exerts a slight pressure on the liquid; on compression,

the liquid on the thicker parts of the object is displaced while the liquid superimposes itself on the thinner parts.

In all embodiments of this invention, the cushions are preferably designed in the shape of a wedge so as to fit the shape of the breast, with the tip of the wedge pointing toward the breast. This ensures that even with relatively low compression, the liquid in the cushion is distributed in such a way that the distribution of the [radiation] dose on the film is approximately uniform.

Claims

1. An X-ray diagnostic device for mammography with a compression mechanism, characterized by the fact that a cushion (5) filled with a breast equivalent liquid is provided between the compression device (3) and the object to be X-rayed (1).

2. The X-ray diagnostic device as claimed in Claim 1, characterized by the fact that the cushion is sealed on all sides and that it consists of an elastic (stretchable) material.

3. The X-ray diagnostic device as claimed in Claim 1, characterized by the fact that the cushion (5) is connected via a tube (6) to a storage container.

4. The X-ray diagnostic device as claimed in Claim 3, characterized by the fact that the storage container contains a gas blanket which exerts a slight pressure on the liquid.

5. The X-ray diagnostic device as claimed in any one of the preceding claims, characterized by the fact that the cushion is attached to the compression mechanism.

6. The X-ray diagnostic device as claimed in any one of the preceding claims, characterized by the fact that the cushion (5) is designed in the shape of a wedge.

Fig.1

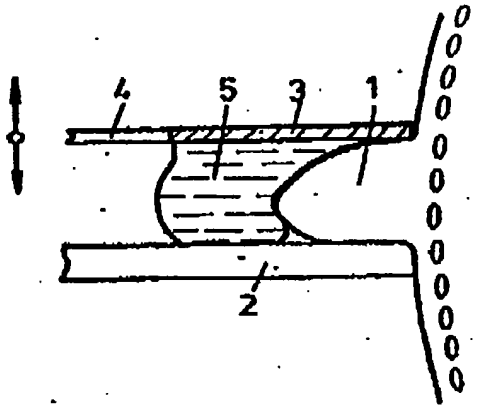

Fig.2

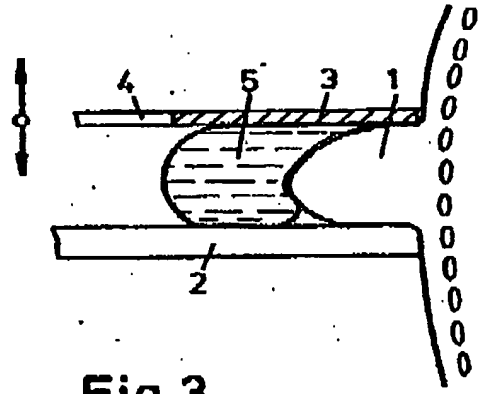

Fig.3